УДК 621.039.538

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STATIC STRENGTH CALCULATION OF SECTION BRANCH PIPE CUTTING-IN OF THE MAKEUP SYSTEM IN THE MAIN CIRCULATION PIPELINE OF REACTOR PLANT WWER-1000

A static strength calculation is one of the calculation methods which are used to justify an operation lifetime extension of reactor plant WWER-1000 equipment. This work presents the static strength calculation of section branch pipe cutting-in of the makeup system in the main circulation pipeline of reactor plant WWER-1000. Based on the calculation it may be concluded that the static strength calculation of section branch pipe cutting-in of the makeup system meets the engineering standard requirements for every design basis operation mode.

Key words: *nuclear power plant, reactor plant, frame-tube system feeding, main circulation pipelines, static strength, extension of service life.*

The main circulation pipeline (fig. 1) is an integral part of the first circuit of the reactor plant. It connects the main equipment of the plant, forming a circulation circuit, and is designed to circulate the coolant from the reactor to the steam generators and back.

Various systems exist to ensure the normal and safe operation of the reactor plant, as well as to control the parameters of the primary circuit.

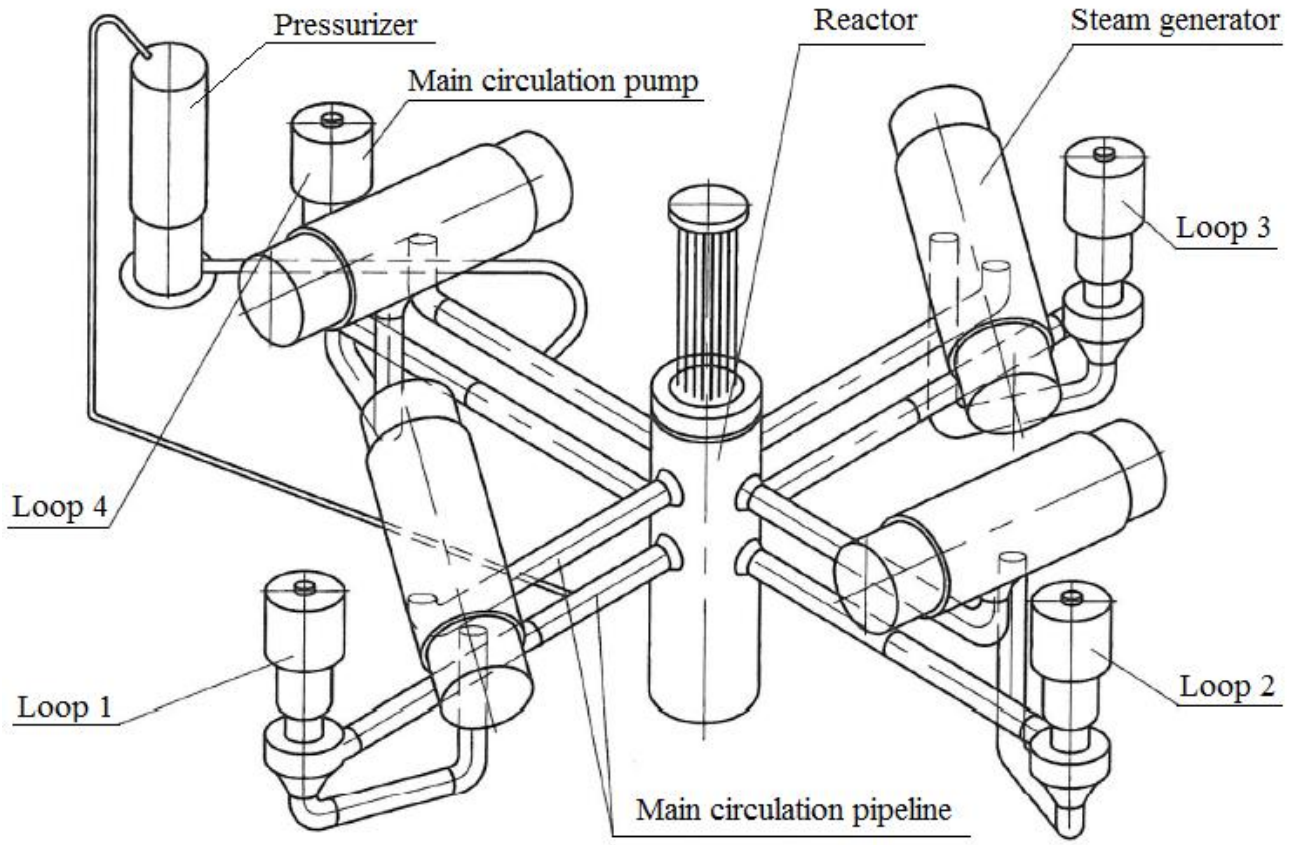

Fig. 1. General scheme of the main circulation pipeline

For example, in the main circulation pipeline welded pipes and fittings, which the main circulation pipeline is connected to various systems. One of these systems is the tie-in Assembly of the feed system fittings (fig. 2).

The calculation of the static strength of the considered node was performed using the ANSYS Mechanical software [1]. At the beginning of the calculation, a finite-elementary model of the tie-in node of the feed system branch pipe into the main circulation pipeline is developed (fig. 3).

When calculating the static strength, the performance of the strength conditions in relation to the node under consideration under the influence of design loads is checked. The stresses determined in the calculation of static strength for the corresponding stress categories in relation to the node under consideration shall not exceed the corresponding allowable stresses.

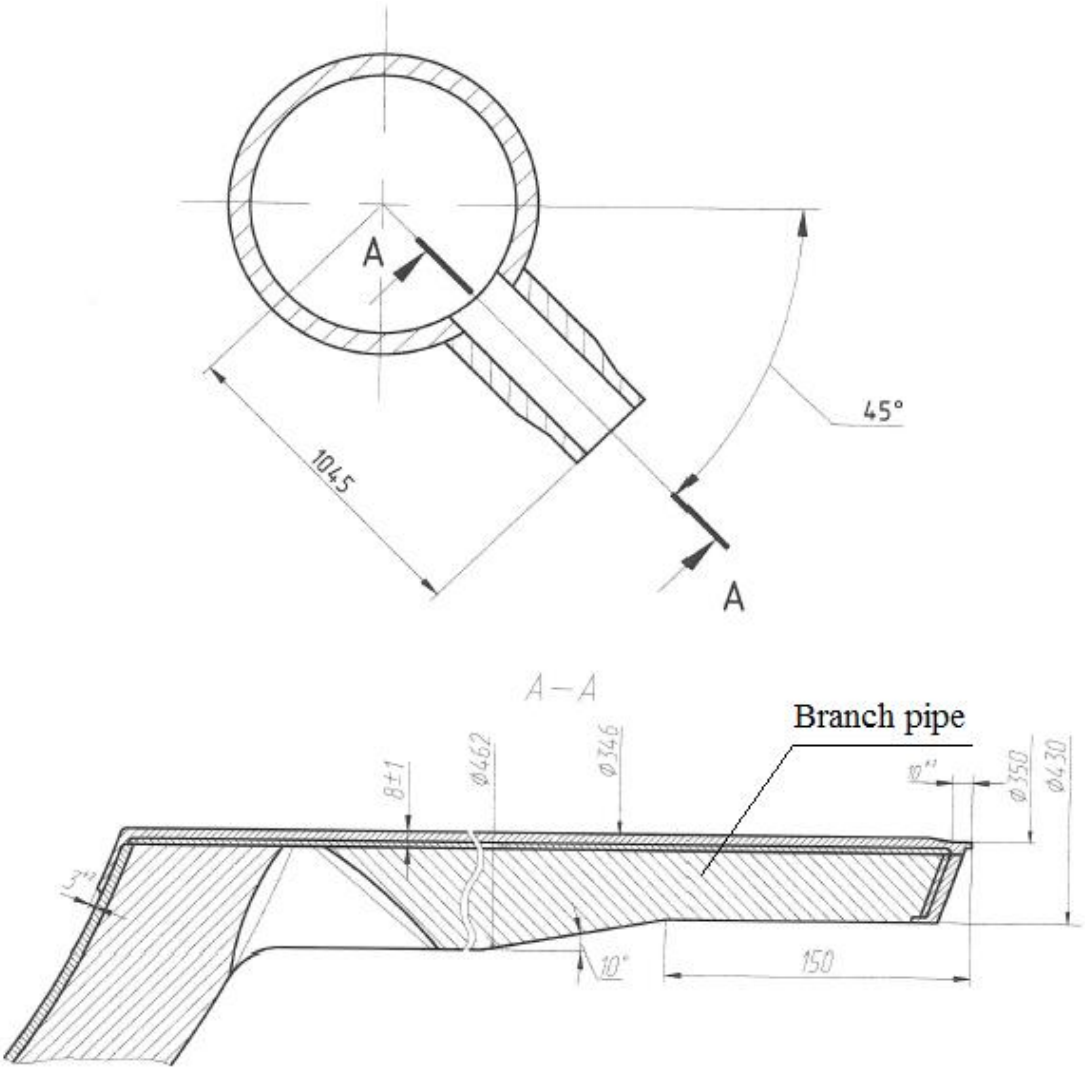

Fig. 2. Sketch of the tie-in node of the feeding system branch pipe

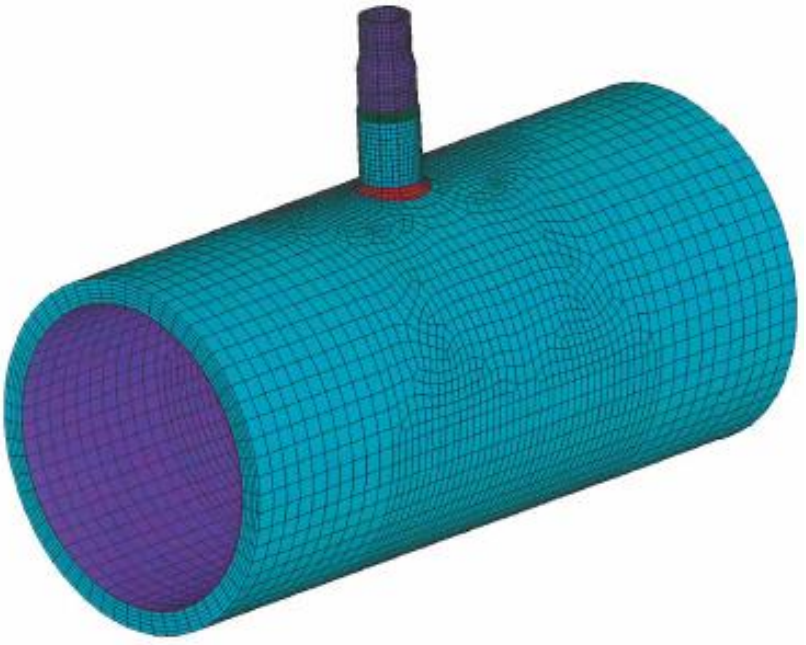

Fig. 3. Sketch of the tie-in node of the feeding system branch pipe

Based on the analysis of the stress States obtained by calculation from the effects of the corresponding loads, the most stressed zones of the considered nodes are selected. Then, in these zones, using the stress linearization method, the corresponding stress categories (common membrane, local membrane, etc.).

The static strength of the element is considered to be provided if the calculated reduced stresses determined by the theory of the greatest tangential stresses for regulated stress groups do not exceed the corresponding permissible stresses [2].

In this paper, the influence of static loads on the insertion of the feed system nozzle into the main circulation pipeline of the VVER-1000 reactor plant was considered. The analysis of the calculation results showed that the given voltages in the main circulation pipeline and the branch pipe for a combination of loads: normal operation violations + design earthquake, normal operation violation + maximum design earthquake does not exceed the corresponding values, therefore, the conditions of static strength of the feed system branch pipe in the GTS correspond to the technical documentation. On the basis of the above, it can be concluded that further operation of the tie-in of the nozzle of the recharge system is considered possible.

References

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